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10/532,239	04/22/2005	Kazuhiro Hagiwara	Q87594	9151

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EXAMINER	
SUMMONS, BARBARA	

ART UNIT	PAPER NUMBER
2817	

DATE MAILED: 09/29/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/532,239	HAGIWARA ET AL.	
	Examiner	Art Unit	
	Barbara Summons	2817	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *22 April 2005 (pre-amendment)*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-8* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-8* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *22 April 2005* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *9/12/05*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Information Disclosure Statement

1. The information disclosure statement filed 9/12/05 fails to comply with 37 CFR §1.98(a)(2), which requires a legible copy of each cited foreign patent document; each non-patent literature publication or that portion which caused it to be listed; and all other information or that portion which caused it to be listed. It has been placed in the application file, but the JP 51-7793 document referred to therein has not been considered. It appears that the only copy of a foreign reference that has been received and has been scanned into the image file wrapper system is the JP 8-321738. However, the Examiner was able to easily view copies of most foreign documents online, except for the noted unconsidered JP 51-7793 document.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. § 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claim 7 is rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 7 recites the feature "said phase shifters" on line 3 thereof. There is insufficient antecedent basis for this feature in the claim, because claim 1 has only switches and no phase shifters. It should be noted that claim 2 has only phase shifters and no switches. Should claim 7 correctly depend from - - one of claim 3 or claim 4 - -?

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. § 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claim 2 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Satou et al. JP 2003-87150 taken alone.

It should be noted that Satoh et al. U.S. 7,010,273 is an English language equivalent of the Japanese document and will be referred to as a translation if need be.

Fig. 3 of Satou et al. discloses a module including a balanced-unbalanced (balun) filter module portion comprising two balun bandpass filters 12 and 13 having different passbands and six phase shifters connected to the bandpass filters, a first phase shifter 10a connected to an unbalanced port of the module and the unbalanced port of a first balun filter 12; a second phase shifter 10b connected to the unbalanced port of the module and the unbalanced port of the second balun filter 13; a third phase

shifter 12a connected to a first balanced port of the first balun filter 12 and to a first balanced port 4a of the module; a fourth phase shifter 12b connected to a second balanced port of the first balun filter and to a second balanced port 4b of the module; a fifth phase shifter 13a connected to a first balanced port of the second balun filter 13; and a sixth phase shifter 13b connected to a second balanced port of the second balun filter 13, whereby a high frequency signal input to the module unbalanced port is output from the first and second balanced ports or vice versa.

However, the fifth phase shifter 13a is not connected to the first balanced port 4a of the module and the sixth phase shifter 13b is not connected to the second balanced port 4b of the module since two separate balanced output ports 4a/4b and 5a/5b are shown, which is different from Applicants' Fig. 3 having one shared balanced port.

Satou et al. does however disclose the desirability of providing the fewest low noise amplifiers (LNAs) at the receiving side (see e.g. the Japanese abstract, lines 2-4 or the last sentence of the US abstract), and accomplishes this by connecting the receiving filters in parallel as shown in Fig. 5.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the module of Satou et al. (Fig. 3) by having connected the two receiving balun filters 12 and 13 in parallel between balanced output ports 4a/4b, thus eliminating ports 5a/5b, as suggested by the exemplary teaching thereof by Satou et al. (Fig. 5), because such an obvious modification would have provided the benefits of reduced parts and thereby reduced size and cost by using

a minimum number of low noise amplifiers (LNAs) as suggested by Satou et al. (ibid. and US '273 col. 4, lines 52-57).

6. Claims 1, 5, 6 and 8 are rejected under 35 U.S.C. §103(a) as being unpatentable over Atokawa U.S. 6,483,399 taken in conjunction with Takamine U.S. 6,713,940 such that either reference can be used to modify the other.

Fig. 4 of Atokawa discloses a receiving multiband filter module for a mobile phone comprising two surface acoustic wave (SAW) filters SF1 and SF2 with different passbands and a first high frequency switch SW1 connected to an unbalanced port of the module being the antenna port and a second high frequency switch SW2 connected to the outputs of the SAW filters and the receiving port of the module.

However, because the SAW filters are not balun filters there is not shown a third switch at the filter outputs for switching the second balanced output of the filters, and the SAW filters with an impedance transformation are not shown.

Fig. 17 of Takamine discloses a receiving multiband filter module for a mobile phone comprising two SAW balun filters (see e.g. 1 and 2 in Fig. 1) and shows a first switch connected to an unbalanced input port of the module and the unbalanced ports of the balun filters. Takamine also discloses the SAW filters with an impedance transformation (see col. 7, lines 51-57), and shows it is known how to connect the balanced output ports in parallel so as to have only one balanced output port (Fig. 16).

However, Takamine does not show second and third switches connected to the balanced outputs of the SAW filters and a balanced port of the module since the device of Fig. 17 has two balanced output ports.

In view of the teachings of the two references it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the SAW filter module of Atokawa (Fig. 4) by having replaced the unbalanced SAW filters SF1 and SF2 with balun SAW filters with necessarily two switches at the balanced outputs thereof, because such an obvious modification would have been the mere substitution of art recognized alternative SAW filters for dual band receivers as evidenced by the exemplary teaching thereof by Takamine (Figs. 1, 16 and 17) and because one of ordinary skill in the art would have known that receiving low noise amplifiers generally require balanced inputs so that such an arrangement utilizing SAW balun filters would have provided the benefit of not requiring a separate balun and hence lowering the number of parts, cost and size. Furthermore, one of ordinary skill in the art would have known that low noise amplifiers generally have a higher than 50 Ohm input impedance and the impedance transforming balun filters suggested by Takamine (col. 7, lines 51-57) would have provided this benefit as well.

It would have been equally obvious to one of ordinary skill in the art at the time the invention was made to have modified the SAW balun filter device of Takamine (Fig. 17) by having provided two switches connected to the balanced outputs of the SAW filters (1301 and 1302 in Fig. 16) and connected to the balanced ports of the module going to a single low noise amplifier (e.g. 165 Fig. 17), because such an obvious modification would have provided the advantageous benefits of needing only one set of module balanced receiving terminals as suggested by Atokawa (see col. 7, lines 1-3;

and Fig. 4 vs. Fig. 1) and Takamine (Fig. 16), and hence only requiring one low noise amplifier, thereby reducing the number of parts, cost and size of the module.

7. Claim 7 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Atokawa U.S. 6,483,399 and Takamine U.S. 6,713,940 as applied to claim 1 above, and further in view of Uriu et al. U.S. 6,606,015

The Atokawa/Takamine combination discloses the invention as discussed above, except for disclosing the device being formed on and in the layers of a laminate.

Uriu et al. discloses that it would have been well known to provide multifrequency modules including switches and phase shifters in a multilayer laminate form with SAW filters and switching devices mounted on top (see Figs. 1, 6 and 7).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the SAW multifrequency module of the Atokawa/Takamine combination by having provided the elements in and on a laminate of a plurality of dielectric layers such as suggested by the exemplary teaching thereof by Uriu et al. (Figs. 1, 6 and 7), because one of ordinary skill in the art would have known that such an arrangement would have provided the advantageous benefit of size reduction since components formerly mounted on the surface of the device may be formed inside the laminate as suggested by Uriu et al. (see col. 18, lines 32-35).

8. Claims 2, 3 and 4 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Atokawa U.S. 6,483,399/Takamine U.S. 6,713,940 as explained in the claim 1 rejection above, and further in view of Ishida et al. JP 8-321738 (cited by Applicants).

The Atokawa/Takamine combination discloses the invention as discussed above, except for disclosing all switches and no phase shifters in the recited locations.

Ishida et al. discloses that it would have been known to use phase shifters (see elements 13 and 14 in section [0012] of the attached machine translation) in place of all or some of the switches (see Fig. 16 vs. Figs. 1 and 8).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the module of the Atokawa/Takamine combination by having replaced all or some of the switches with phase shifters, such as suggested by the exemplary teaching thereof by Ishida (ibid.) because such an obvious modification would have provided the benefits of less power consumption since no switch control signal is required and less deterioration in the insertion loss property due to switch loss, as also suggested by Ishida et al. (see e.g. section [0005]).

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Machui U.S. 6,861,924 discloses switching between two transmitting and two receiving filters for multiband modules (see Figs. 4-6).

Shibahara U.S. 6,914,477 discloses multiband modules with phase shifters before and after both filters (see Fig. 1).

Takamine U.S. 6,606,016 discloses another example of how balun SAW filters have their balanced outputs connected in parallel (see Fig. 15) and including SAW phase shifting resonators 9 and 9a.

Atokawa JP 2001-160766 is a Japanese equivalent of the U.S. document applied above cited for Applicants' convenience.

Ueda et al. U.S. 6,115,592 also discloses a dual band module (Figs. 2, 3 and 8) with two filters connected in parallel with phase/impedance matching elements.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Barbara Summons whose telephone number is (571) 272-1771. The examiner can normally be reached on M-Th, M-Fr.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bob Pascal can be reached on (571) 271-1769. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

bs
September 26, 2006
(1 Attachment)

Barbara Summons

BARBARA SUMMONS
PRIMARY EXAMINER

Attachment 1

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the number band-pass filter of dual tone multifrequencies, the number splitter of dual tone multifrequencies, and the number composition machine of dual tone multifrequencies.
[0002]
[Description of the Prior Art] In recent years, development of a mobile transmitter prospers and the system of various frequency bands has come to be employed. Then, the need of treating the signal of two or more frequency bands also in the wireless section of a transmitter in the same circuit is being born. In a wireless circuit, the band-pass filter and frequency splitter (synthetic vessel) which are an important circuit element follow various difficulties on treating two or more frequency bands especially.

[0003] Hereafter, the number band-pass filter of dual tone multifrequencies which can pass two frequency bands of the conventional example is explained first, referring to a drawing. Drawing 12 is the body circuit diagram of the number band-pass filter of dual tone multifrequencies of the conventional example. In drawing, 121 is the 1st band-pass filter of 950MHz of frequency passbands, and 122 is the 2nd band-pass filter of 1.9GHz of frequency passbands. The common input terminal 124, the common output terminal 125, and the input/output terminal of these filters can be connected with the filter circuit changing switch 123, respectively, and the whole passband can be changed by changing these switches to a 1st or 2nd filter side synchronously.
[0004] Next, the number splitter of dual tone multifrequencies of the conventional example is explained. Drawing 13 is the body circuit diagram of the number splitter of dual tone multifrequencies of the conventional example. In drawing, it is the 1st band-pass filter of 950MHz of 131 frequency passbands, and 132 is the 2nd band-pass filter of 1.9GHz of frequency passbands. By changing the common input terminal 134 and the input terminal of each of these filters with the output circuit changing switch 133, it becomes possible to take out the frequency component of a 950MHz band to the 1st output terminal 135, and to take out the frequency component of a 1.9GHz band to the 2nd output terminal 136. Moreover, the number composition machine of dual tone multifrequencies can also consist of replacing an input and an output.
[0005]
[Problem(s) to be Solved by the Invention] However, with the configuration of the above conventional examples, the control signal of a circuit changing switch is needed also in any of the number band-pass filter of dual tone multifrequencies, and the number splitter of dual tone multifrequencies (synthetic vessel). There is a possibility that the whole insertion-loss property may furthermore also deteriorate by loss of a circuit changing switch.
[0006] This invention was not made in order to improve the above-mentioned conventional trouble, in order to satisfy the above-mentioned property using a passive element, without using a circuit changing switch, is control signal needlessness and aims at offering the whole good number band-pass filter of dual tone multifrequencies and the whole number splitter of dual tone multifrequencies (synthetic vessel) of an insertion-loss property.
[0007]

[Means for Solving the Problem] In order to attain the above-mentioned object, the number band-pass filter of dual tone multifrequencies of this invention is the configuration of having connected the ends with the impedance matching circuit pair connected to the input/output terminal of the 1st and 2nd band-pass filter by the common input/output terminal.

[0008] Moreover, the number splitter of dual tone multifrequencies (synthetic vessel) is a configuration which connects the opposite hand of the impedance matching circuit connected to the 1st and 2nd band-pass filter and each input (output) terminal, and a matching circuit with a common input (output) terminal, and takes out the output (input) terminal of each remaining band-pass filter as it is.

[0009]

[Function] In the above-mentioned configuration, the number band-pass filter of dual tone multifrequencies of this invention changes the frequency band corresponding to the passband of the 2nd band-pass filter of the 1st band-pass filter into a high impedance by the impedance matching circuit pair linked to the input/output terminal of the 1st band-pass filter, in case the passband of the 2nd band-pass filter exists outside the passband of the 1st band-pass filter. Similarly, in case the passband of the 1st band-pass filter exists outside the passband of the 2nd band-pass filter, the frequency band corresponding to the passband of the 1st band-pass filter of the 2nd band-pass filter is changed into a high impedance by the impedance matching circuit pair linked to the input/output terminal of the 2nd band-pass filter. By connecting these by the common input/output terminal, the number band-pass filter of dual tone multifrequencies which does not influence each 1st and 2nd passband is obtained.

[0010] Moreover, although the number splitter of dual tone multifrequencies of this invention (synthetic vessel) performs the same impedance conversion as the number band-pass filter of dual tone multifrequencies in the above-mentioned configuration It is used only for an output side only for an input side at the time of a synthetic vessel at the time of a splitter, each is connected by the common terminal, and another side is referred to as the output (input) terminal 1st and the 2nd as it is. In the case of a splitter, the signal of two or more frequency band components transmitted common to a common input terminal is separated only by loss of each filter for every passband of each band-pass filter, and, in the case of a synthetic vessel, it has the operation which compounds the frequency component for every passband of each band-pass filter only by loss of each filter.

[0011]

[Example] The number band-pass filter of dual tone multifrequencies of the 1st example of this invention is explained referring to a drawing below. Drawing 1 is an auxiliary view for the body block diagram of the number band-pass filter of dual tone multifrequencies of the 1st example of this invention, drawing 2 - drawing 6 to explain this example. In drawing 1 , 11 is the 1st band-pass filter of the 950MHz band of passbands, and 12 is the 2nd band-pass filter of the 1.9GHz band of passbands, and an output terminal with 13 [common / the 1st phase machine of the passage phase angle phi 1, an input terminal with 14 / common / the 2nd phase machine of the passage phase angle phi 2, and 15 /, and 16].

[0012] Next, the actuation is explained. What plotted the I/O impedance of each 1st and 2nd filter to drawing 2 (a) and (b) at the Smith chart is shown. Generally, although it has an impedance characteristic near the core of a chart since the band-pass filter is adjusted in the characteristic impedance in a passband, it has the impedance characteristic which is attached outside a passband on the outside of a chart. The passage property of each 1st and 2nd filter is shown in drawing 3 . Since the signal of the passband of the 1st filter 11 has the low impedance of the band of the 2nd filter 12, and it will flow in there and will lose, for example if parallel connection of each of these filters is carried out simply and an input/output terminal is connected in common, it will become a passage property as shown in drawing 4 , an insertion loss will deteriorate, and a filter shape will collapse. Then, the isolation of each filter is conventionally taken using the circuit changing switch 123 as shown in the conventional example of drawing 12 . In this example, the required circuit changing switch of a control signal like the conventional example is not used, but the phase machine of the passage phase angles phi1 and phi2 is connected to the input/output terminal of each filter. The magnitude of the phase angle phi 1 of the 1st phase machine 13 is adjusted to a suitable include angle so that the impedance of the 1.9GHz band of passbands of the 2nd filter 12 may serve as a high impedance value in the 1st filter 11, as shown in drawing 5 (a). The magnitude of the phase angle phi 2 of the 2nd phase machine 14 is adjusted to a suitable include angle so that the impedance of the 950MHz band of passbands of the 1st filter 11 may serve as a high impedance value in the 2nd filter 12, as similarly shown in drawing 5 (b). Parallel

connection of these is carried out and it connects by the common input terminal 15 and the output terminal 16. In this case, since the impedance of the 950MHz band by the side of the 2nd filter serves as a high impedance value near disconnection, there is almost no leak of the 950MHz band component by the side of the 2nd filter, and the insertion-loss property of the 1st filter is also saved. Since the impedance of the 1.9GHz band by the side of the 1st filter serves as a high impedance value near disconnection similarly, there is almost no leak of the 1.9GHz band component by the side of the 1st filter, and the insertion-loss property of the 2nd filter is also saved. For this reason, the whole passage property turns into a property as shown in drawing 6 .

[0013] Moreover, the number splitter of dual tone multifrequencies of the 2nd example of this invention is shown in drawing 7 . For the 1st band-pass filter of the 950MHz band of passbands, and 72, as for the 1st phase machine of the passage phase angle phi 1, an input terminal with 74 [common / the 2nd phase machine of the passage phase angle phi 2, and 75], and 76, in drawing 7 , the 2nd band-pass filter of the 1.9GHz band of passbands and 73 are [71 / the 1st output terminal and 77] the 2nd output terminal. So that the impedance of the 1.9GHz band of passbands of the 2nd filter 72 may serve as a high impedance value in the 1st filter 71 by the same principle as the 1st example mentioned above about this So that the magnitude of the phase angle phi 1 of the 1st phase machine 73 may be adjusted to a suitable include angle and the impedance of the 950MHz band of passbands of the 1st filter 71 may serve as a high impedance value in the 2nd filter 72 There is almost no leak of the 1.9GHz band component from the input terminal 75 common to adjusting the magnitude of the phase angle phi 2 of the 2nd phase machine 74 to a suitable include angle to a 2nd filter side, and the leak of the 950MHz band component by the side of the 1st filter is almost lost. To the 1st output terminal 76, only a 950MHz band component can take out only by the transmission loss of the 1st filter by this, and the number splitter of dual tone multifrequencies which only a 1.9GHz band component can take out only by the transmission loss of a filter can be constituted in the 2nd output terminal 77.

[0014] Next, the number band-pass filter of dual tone multifrequencies of the 3rd example of this invention is explained. Drawing 8 is the body block diagram of the number band-pass filter of dual tone multifrequencies of the 3rd example of this invention. The 1st and 2nd band-pass filter of the definition as the 1st example with 81 and 82 and 83 are the electric merit's L1 1st transmission line, an input terminal with 84 [common / the electric merit's L2 2nd transmission line, and 85 and 86], and an output terminal. [same] So that the impedance of a 1.9GHz band may serve as a high impedance value in the 1st filter 81 like the 1st example So that the magnitude of the electric merit L1 of the 1st transmission line 83 may be adjusted to suitable die length and the impedance of a 950MHz band may serve as a high impedance value in the 2nd filter 82 The same effectiveness as the 1st example can be acquired by adjusting the magnitude of the electric merit L2 of the 2nd transmission line 84 to suitable die length. Moreover, the number splitter of dual tone multifrequencies of the 4th example of this invention is shown in drawing 9 . The same effectiveness as the 2nd example can be acquired by the same principle as the configuration made into the transmission line showed the phase machine of the 2nd above-mentioned example to the 3rd example.

[0015] Next, the number band-pass filter of dual tone multifrequencies of the 5th example of this invention is explained. Drawing 10 is the body block diagram of the number band-pass filter of dual tone multifrequencies of the 5th example of this invention. The 1st and 2nd band-pass filter of the definition as the 1st example with 101 and 102 and 103 are the low pass filter of the 950MHz band of passbands, an input terminal with 104 [common / the high pass filter of the 1.9GHz band of passbands, and 105 and 106], and an output terminal. [same] The component value of circuit elements, such as a capacitor of a low pass filter 103 and a coil, is adjusted, and magnitude of the passage phase angle of a 1.9GHz band is made into a suitable include angle so that the impedance of a 1.9GHz band may serve as a high impedance value in the 1st filter 101 like the 1st example. Furthermore, the component value of circuit elements, such as a capacitor of a high pass filter 104 and a coil, can be adjusted, and the same effectiveness as the 1st example can be acquired by making magnitude of the passage phase angle of a 950MHz band into a suitable include angle so that the impedance of a 950MHz band may consider as a high impedance value also in the 2nd filter 102. Moreover, the number splitter of dual tone multifrequencies of the 6th example of this invention is shown in drawing 11 . The same effectiveness as the 2nd example can be acquired by the same principle as the configuration used as the low pass filter and the high pass filter showed the phase machine of the 2nd above-mentioned example to the 5th

example.

[0016] Here, although the lumped-constant-circuit component was used as a low pass filter and a broader-based passage filter in the 5th and 6th example, the same effectiveness is acquired even if it constitutes this using a distributed constant circuit.

[0017] Next, the example of implementation of dielectric laminating unification of the number band-pass filter of dual tone multifrequencies of the 5th example is shown in drawing 12 as the 7th example. The example shown in drawing 12 is an example which piled up two band-pass filters up and down, and was unified. In drawing 12 , 12a-12h are the dielectric layers from the 1st layer to eight layers, and the 1st, 2 and the 3rd touch-down shielding layer, and 12j, 12k, 12m, and 12n of 12i, 12l., and 12o are the 1st to 4th pattern layer. The 1st band-pass filter constituted by the capacitor formed with the counterelectrode for combining two quadrant wavelength resonators and these with which the part of 121 connected the head too hastily, The 2nd band-pass filter constituted by the capacitor formed with the counterelectrode for combining two quadrant wavelength resonators and these in which the part of 122 has different resonance frequency from the resonator contained in 121, The low pass filter which consists of serial coils formed by leading about of the touch-down capacitor and line in which the part of 123 formed with the counterelectrode, As for an output terminal and 127, the series capacitor which the part of 124 formed with the counterelectrode, the high pass filter which consists of touch-down coils formed by leading about of a line, and 125 are [an input terminal and 126] earth electrodes. In this configuration, the same effectiveness as the 5th example can realize the number band-pass filter of dual tone multifrequencies, and it also becomes possible by unifying to realize the miniaturization of circuit magnitude.

[0018] Next, the 7th example of dielectric laminating unification of the number band-pass filter of dual tone multifrequencies of the 5th example shows a different example of implementation to drawing 13 as the 8th example. This example arranges two band-pass filters horizontally, and unifies. In drawing 13 , 13a-13e are the dielectric layers from the 1st layer to five layers, and the 1st, the 2nd touch-down shielding layer, and 13g and 13h of 13f and 13i are the 1st and 2nd pattern layer. the part of 131 -- the 1st band-pass filter and the part of 132 -- for an input terminal and 136, an output terminal and 137 are [the 2nd band-pass filter and the part of 133 / a low pass filter and the part of 134 / a high pass filter and 135 / an earth electrode and 138] internal screening electrodes. The number band-pass filter of dual tone multifrequencies is realizable with the effectiveness as the 5th example that the 7th example is also the same. The miniaturization of circuit magnitude is realized still like the 7th example, and although surface area becomes large rather than the 7th example, it becomes possible to constitute height small. Especially in especially pocket machines, such as mobile communications, it is called for in many cases that height is smaller than surface area, and this example is useful for such examples of application.

[0019] Moreover, the example of implementation of dielectric laminating unification of the number splitter of dual tone multifrequencies of the 6th example is shown in drawing 14 as the 9th example. The example shown in drawing 14 is an example which piled up two band-pass filters up and down, and was unified. In drawing 14 , 14a-14h are the dielectric layers from the 1st layer to eight layers, and the 1st, 2 and the 3rd touch-down shielding layer, and 14j, 14k, 14m, and 14n of 14i, 14l., and 14o are the 1st to 4th pattern layer. the part of 141 -- the 1st band-pass filter and the part of 142 -- for a high pass filter and 145, as for the 2nd output terminal and 147, an input terminal and 146 are [the 2nd band-pass filter and the part of 143 / a low pass filter and the part of 144 / the 1st output terminal and 147] earth electrodes. In this configuration, the same effectiveness as the 6th example can realize the number splitter of dual tone multifrequencies, and it also becomes possible by unifying to realize the miniaturization of circuit magnitude. Drawing 15 shows similarly the example of implementation from which the 9th example of dielectric laminating unification of the number splitter of dual tone multifrequencies of the 6th example differs as the 10th example. This example arranges two band-pass filters horizontally, and unifies. A configuration is almost the same as the example of **** 8, 156 is the 1st output terminal and 157 is the 2nd output terminal. Also in this configuration, the same effectiveness as the 6th example can realize the number splitter of dual tone multifrequencies, and it also becomes possible by unifying to realize the miniaturization of circuit magnitude. Furthermore, although surface area becomes large rather than the 9th example, height can be made small, and it is useful to a cellular phone etc. as point **.

[0020] In addition, in the 7th to 10th example, although the band-pass filter used what was constituted from two head short circuit mold quadrant wavelength resonators, three or more plurality is sufficient as

the number of resonators, and the thing of another configuration of not using a resonator can also acquire the same effectiveness.

[0021] Moreover, although it has set in the 2nd, 4th, 6th, 9th, and 10th examples and the gap also explained the splitter, it is clear that a synthetic vessel is obtained by replacing an input and an output.

[0022] In addition, although the frequency of a 950MHz band and a 1.9GHz band was used as a passband of the 1st and 2nd band-pass filter in this example for the simplification of explanation, if the conditions of a frequency which the frequency of the passband of the 2nd filter already described in the example highly rather than the frequency of the passband of the 1st filter are satisfied, it cannot be overemphasized that it can realize in the combination of any numbers of dual tone multifrequencies.

[0023] Furthermore, although this example described the band-pass filter in the number of dual tone multifrequencies, the splitter, and the synthetic vessel, a wave number splitter and a synthetic vessel can be constituted two or more rounds in two or more round wave number band-pass filter corresponding to two or more round wave number of three or more frequencies which are different if the same technique is used, and a list.

[0024]

[Effect of the Invention] As explained above, by equipping the number band-pass filter of dual tone multifrequencies of this invention with the 1st and 2nd impedance matching circuit pair linked to I/O of the 1st and 2nd band-pass filter and the 1st and 2nd band-pass filter as a fundamental configuration, changing the I/O impedance of the 1st and 2nd band-pass filter, and connecting, it is control signal needlessness and the small number band-pass filter of dual tone multifrequencies of the whole insertion loss can be realized.

[0025] Furthermore, in the number splitter of dual tone multifrequencies (synthetic vessel), by connecting the 1st and 2nd impedance matching circuit only to the input (output) of the 1st and 2nd band-pass filter, it is control signal needlessness and the small number splitter of dual tone multifrequencies of the whole insertion loss (synthetic vessel) can be realized.

[Translation done.]